

Nitrate Loading History, Fate, and Origin for Two Wisconsin Groundwater Basins

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Agricultural disturbances since settlement times have changed the nitrogen cycle in the agricultural Midwest, including Wisconsin. These changes include rapid mineralization of soil organic matter, nitrogen fixation by legumes, additions of manure, and beginning about 40 years ago, large inputs of chemical nitrogen fertilizer. A result has been large losses of nitrate to ground and surface water. Only recently have university and state agencies put together sufficient pieces of the nitrate groundwater puzzle to realize its extent and that it is apparently increasing. Even so, our understanding is poor of how present groundwater nitrate conditions evolved and what future nitrate trends will be. This project's goal is to help fill the key gaps in the understanding of nitrate in Wisconsin groundwater, including (1) the time over which current nitrate conditions evolved; (2) the relative importance of various sources of groundwater nitrate (fertilizer, manure, soil organic matter); (3) long-term nitrate fate; and (4) time required for nitrate conditions to achieve steady-state. Filling these gaps is necessary if the state is to move from a reactive to proactive nitrate management mode.

The objective of this research is to determine the input history, fate, and origin of groundwater nitrate in two agricultural groundwater basins, and on this basis qualitatively project future nitrate conditions in these and similar areas. Two contrasting basins, the Little Plover River Basin and the Lake Mendota Watershed, have been selected. This project's premise is that the groundwater history of nitrate loading and its fate is retained in the spatial structure of an aquifer. By acquiring samples from different positions within a groundwater flow system and subjecting them to appropriate analyses (nitrogen species, geochemistry, age dating), nitrate loading, fate, and origin information can be extracted. Loading and fate information in turn can provide us with a basis for projecting future nitrate trends.

Project Update

The Little Plover Basin was instrumented with 24 monitoring wells nested at 6 locations along an 8.3-km groundwater flow path. These wells were sampled in April and May 2002 for a suite of inorganic analyses, dissolved gases, and selected pesticide residues (DATCP is funding a pesticide analysis work as part of a related study). Inorganic and gas analyses have been completed. Pesticide analyses are in progress. Potential sample sites in the Lake Mendota watershed are being explored for investigation later this year.